ENERGY EFFICIENCY AND THE CONSTRUCTION SECTOR IN THE DANISH MEDIA

Working paper

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INTRODUCTION

Energy efficiency of buildings is today under a loop. In the EU, the building sector accounts for some 33% of the CO^2 emissions contributing to climate change (FIEC 2007) resulting predominantly form energy use in buildings. The Danish building sector has been estimated to have a reduction potential of up to 50% in terms of energy savings (The Danish Construction Association 2004, En visionær Dansk energipolitik 2007). While much of the existing literature focuses on the energy savings potential and technical feasibility for energy effectivizing the building sector (Boardman 2006, Lowe 2007, Nässén and Holmberg 2005, Pérez-Lombard et al. 2008, Tommerup and Svendsen 2006, Ürge-Vorsatz et al. 2007, Banfill and Peacock 2007, Battle et al. 2006, Bechrakis et al. 2006, Sartori and Hestnes 2007, Tommerup et al. 2007), little of the potential is fulfilled.

This paper inquires into how energy efficient construction, its achievement or the lack of this is portrayed in the Danish newspaper media. The focus of this paper is in the discursive stabilization and destabilization of different themes involved in the achievement or dispelling of energy efficiency. This paper maps these themes and analyzes their evolvement in the texts produced by the Danish print media between 1999-2008. The discursive stabilizations of themes, problems and solutions given in the Danish media are seen as interesting as for their significant role in the society: they participate in categorizing, naming and enrolling actors and their relations and thereby defining the meaning of energy efficiency (Fairclough 1995).

This paper is divided into four parts addressing the prevalent themes related to energy efficiency in the construction sector: 1) physical and material themes of energy efficient construction, 2) standards and labels, 3) change in work practices, and 4) economy in energy effectivizing. The first part, practical themes in energy efficient construction is divided into three parts including heat maintenance, solar power (photovoltaic cells and thermal collectors) and retrofitting. These topics are chosen for closer investigation due to their prominence in the media material. The following chapters present the main topics under each theme including issues, problems, controversies and solutions. Before embarking on the analysis, the methods employed in the research will be briefly introduced.

METHODS AND MATERIALS

This paper takes offset from newspaper and magazine articles. The data used in this paper has been retrieved from four daily newspapers (Jyllands-Posten, Politiken, Berlinske Tidende and Børsen) and six weekly or monthly professional magazines which represent either architects (Arkitekten, Arktema), building sector (Byggeriet), engineers (Ingeniøren) or the municipalities (Nyhedsmagasinet Danske Kommune) or the business life in general (Ehrvervsbladet, Børsen). The mix of these newspapers and magazines presents the Danish construction sector but also the society in broader terms. The meanings under scrutiny are those woven together discursively in the writings of these media. This, of course, leaves out the processes of meaning production that happen in interplay between different actors in their situated practices, media or other.

Articles that matched with word energy in the construction sector magazines and energy and construction in other magazines and newspapers were collected. Altogether 387 articles with relevance to energy efficiency were found. Articles in magazines Arkitekten and Arktema were not available in digital form and were sorted manually. Byggeriet was only available from 2003 whereas the other newspapers and magazines were covered over a time period of between January 1998 and June 2008. This time span was chosen on one hand for its relevance for today's building practices. On the other hand it was assumed that the revision of the energy regulations in the Danish Building Code in 2006 would lead to articulation of energy efficiency related interests and meanings in the media.

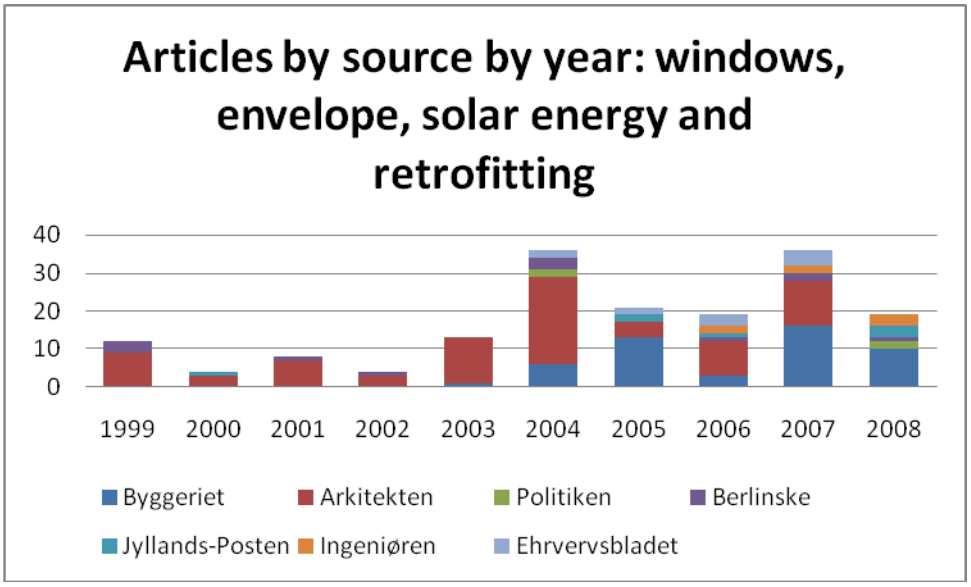
The analysis was facilitated by grouping the material by source and according to which dimension of energy efficiency it was related to. These dimensions were teased out off the data by mapping all the thematic areas that were articulated as being relevant for achieving energy efficiency. In the media, energy efficiency was discussed in relation to several different yet partly overlapping thematic areas. To this paper four of the most prominent themes were chosen: 1) physical and material themes of energy efficient construction, 2) standards and labels, 3) change in work practices, and 4) economy in energy effectivizing. Of these four areas, by far the most prominent was that of energy efficiency of the building and in its elements. Within this area, topics such as solar heating end electricity, heat maintenance and retrofitting, were featured most prominently and are thus discussed in this paper.

The four themes are partly overlapping as for example economy is also portrayed in relation to most other themes. Other possible topics would have been building regulations (now reflected upon under each theme) and for example different technologies such as heat circulation pumps and geothermal heating. The latter have been left out by choosing some more frequently discussed technical and material topics.

After the initial categorization of the empirical material into four thematic areas, an analysis was carried out resulting in a text describing the most discussed themes and their possible evolvement within each theme.

BUILDINGS AS PHYSICAL AND MATERIAL ENTITITES

In the following, I will discuss the energy efficiency related topics concerning the most discussed technological and material areas: heat maintenance, retrofitting and solar energy for heating and electricity. In the end of this subchapter, I will briefly wrap up the main features in the discussion about the physical and material dimensions of buildings.



The amount of articles addressing these topics has increased from 2004 onwards. This can at least partly be explained by the inclusion of Byggeriet magazine in the data sample from 2003 onwards and the more regular coverage by the daily media. The most active discussants were Arkitekten and Byggeriet.

The focus of Arkitekten and Byggeriet, the two magazines with the largest number of articles in this area, were very similar yet they differed in three issues. While Arkitekten discussed the impact of energy saving glass on day light quality and the impact of air tightness on indoor climate, these issues remained undiscussed in Byggeriet. Byggeriet was, on the other hand, the only media where the hurdles for window renovations were discussed.

Heat maintenance in buildings

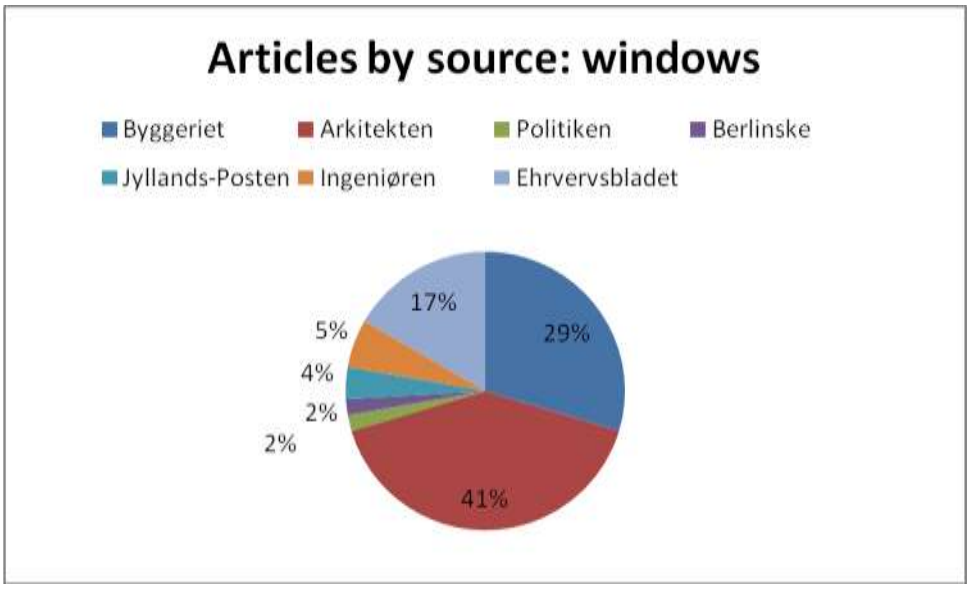
Heat loss through window solutions and building envelope was widely considered problematic in terms of energy efficiency in the media. According to DTU and Byggeriet, for example, windows were seen as one of the foremost areas of interest in respect to increasing energy efficiency[i]. In 2008, according to the Danish Technical University (DTU), the Danish house owners were likely to loose 50% of their energy used for heating through poorly insulated windows and doors[ii]. Byggeriet was also active in bringing in estimations on the economic profitability of energy renovation including window and building envelope renovation[iii].

The general approach to heat loss through windows and the building envelope was thus that this was undesirable. In the following, I will discuss the ways in which problems with heat maintenance were negotiated, neutralized, maintained and suspended in the media.

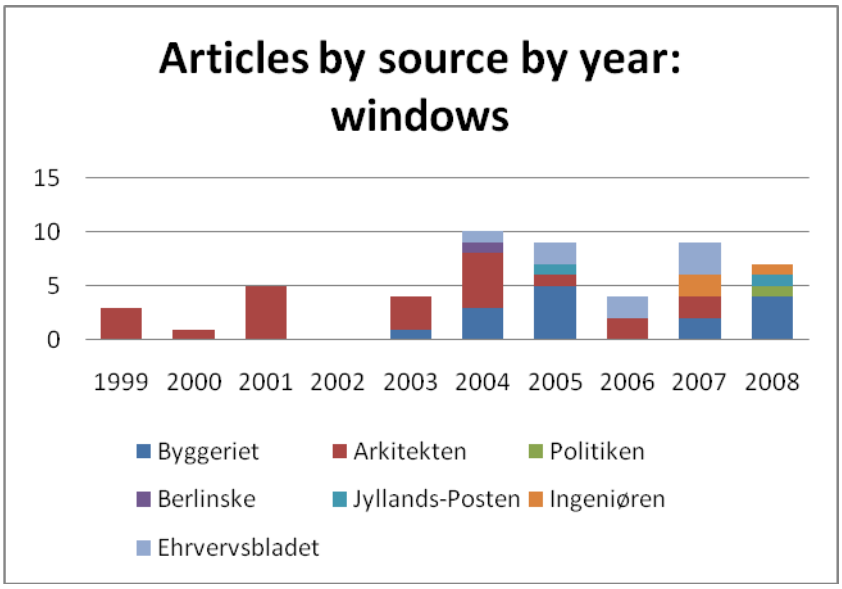
The following analysis is dealt in two parts: a part discussing heat maintenance in relation to windows and a part discussing the heat maintenance in relation to the building envelope. These two areas of buildings were treated separately in the media, yet there are similarities in relation to the main issues that were taken into consideration when heat maintenance was discussed in both areas. The two main issues structuring the debate in the media around heat maintenance in both areas were the heat loss through air bridges and the heat loss through building components.

Windows

One of the discussed dimensions of energy efficiency was that related to heat maintenance in the realm of windows (25 articles) featuring a debate on heat loss through window glass and through air bridges between the different building components. The discussion was mostly carried out in Arkitekten and Byggeriet. Berlinske Tidende, Politiken, Jyllands-Posten, Ehrvervsbladet and Ingeniøren, however, also contributed with a handful of articles. While Arkitekten and Byggeriet frequently published on this topic, their focus was slightly different. Arkitekten was the only media discussing the day light quality question in relation to energy saving window glass while window renovation questions were left to Byggeriet.



The amount of articles on windows, however limited increased from 2004 onwards. This can be partly explained by the inclusion of Byggeriet in the data sample from 2003 onwards. Furthermore, while Arkitekten previously had been the only media intereseted in energy efficiency and windows, the daily news media also became more active at this point.



Heat maintenance and window glass

In the late 1990s, according to Arkitekten, window producers had been able to develop energy efficient coated window glass. The insulation effect of the glass was even compared to that of a wall[iv]. A glass producer, Pilkington, stated in Arkitekten, that the insulation quality of the window glass was not a problem for energy efficiency at that point[v]. In 2001, Arkitekten reported on a new energy glass Optitherm SN from Pilkington. This glass combined enhanced insulation and heat and light gain better than energy glasses had done before[vi]. In 2006 and 2007, Arkitekten mentioned two new energy efficient glass types: a German Okalux window with capillary insulation and Primalux roof window[vii]. In 2008 and 2007, Byggeriet and Ehrvervsbladet referred to SBi (The Danish Building Research Institute) and Byggecentrum (an information centre for the construction sector), respectively and stated that even all-glass facades were able to fulfil the energy efficiency requirements in the new and stricter building code from 2006[viii]. According to Arkitekten, however, the use of energy efficient glass types was, however, not very usual in Denmark in the late 1990's and at least until 2001[ix]. In a way then, an interesting tension between the potential and acquired state of affairs emerges from the media writings.

The media writings do not explicitly discuss this tension between the possible and the actual. However, several issues that might influence this are brought up. The Danish Energy Agency launched a project 'Window' in 1998. It opened a fund of 100 million DKK for 1998-2003 to develop energy savings in buildings, including enhancing the sale of energy glass[x]. According to Byggeriet, this campaign aimed for mobilizing building professionals to market more energy efficient solutions[xi]. Furthermore, The Danish Energy Agency and the window and glass branch organization established a voluntary energy labelling of windows in 2000[xii]. This energy labelling, according to Ehrvervsbladet, aimed at informing the users of the energy performance dimension of windows[xiii]. This focus on different promoting measures seems indicates

difficulties in mobilizing clients and building professionals. According to Ehrvervsbladet, an agreement between the window producers on outphasing the traditional window glass was established in 2006[xiv].

Another issue related to the difficulties in using the technical solution, the energy saving glass, as a tool for dissolving the problem with heat maintenance was articulated by Arkitekten in the late 1990s. Arkitekten gave voice to concerns regarding the day light quality when coated energy glass was used. An architect who was specialized in the day light issues noted that the coated glass was experienced as darker and influenced the way people saw details and differences. Architects were blamed for not being conscious enough about light quality issues and were thus lead by engineers who mainly thought about the balance in heat[xv]. On the other hand, Arkitekten also stated that research on this issue was lacking[xvi]. If the energy saving glass was used, new problems appeared in the form of worse day light quality. From 2001 onwards, the day light quality question was not discussed any more in Arkitekten or in any other newspaper or magazine.

Air bridges and windows

In the media, air bridges in plastic and metal based window frames formed another window related problem for heat maintenance. While the insulation performance of new glass types had been remarkably enhanced, Arkitekten wrote about the energy efficiency of window frames lacking behind the development of energy efficiency already in the end of 1990s[xvii]. The Danish Building Research institute (SBi) had been carrying out research on frames, but it had been difficult to get producers to change their old production methods[xviii]. In 2003, a researcher from Danish Technical University (DTU), reported on a shared product development project with a Danish window producer where good results with the air bridges had been achieved. Again, the producer opted for not changing its production; this time because the old type of windows were selling well[xix]. It was difficult to mobilize Danish window producers to work against air bridges.

In 2003, a researcher from DTU stated in Arkitekten that energy efficient window frames were available both in Germany and Sweden. However, these were seen as too broad for the Danish taste[xx]. In 2006, the most energy efficient windows were provided by German, Swiss and Austrian entrepreneurs[xxi]. The energy saving window solutions were available, yet their use remained limited.

According to Arkitekten (2006), the Danish companies remained disinterested in experimenting with energy saving window frames[xxii]. However, from 2004 onwards, articles on testing and production of energy efficient window frames for the Danish taste by Danish producers had started to appear in Arkitekten, Byggeriet, Ehrvervsbladet and Ingeniøren. Products named included Primo[xxiii], Fiberline windows[xxiv] and Protec7[xxv] in new plastic materials which allowed for thinner yet air tight frames. In Byggeriet, DTU stated that the heat loss of the buildings through windows could be decreased remarkably if this type of window frames would be used[xxvi]. In principle, the aesthetic concerns could be neutralized through using the new window frames. The media does not discuss to what extent this happened. What, however, is discussed is the building up of a supporting network for the energy efficient window frames.

In 2005, the voluntary energy labelling of windows was extended to the window frames, instead of focusing solely on the glass type[xxvii]. Furthermore, a campaign by the Danish Energy Agency, Glass industry, VSO and the executing organization was carried out to market the energy labelled window solutions aiming at mobilizing the building professionals with client contacts[xxviii]. Related to the campaign, the Danish Construction Association, Danish Energy Agency, the Association of Danish Glass Manufacturers, the Association of Danish Window Manufacturers, the Guild of Window Glazers (Glarmesterlauget) and Danish Federation of Small and Medium-sized Enterprises educated 208 window specialists among building site workers and window producers between 2005 and 2007[xxix]. Overlapping with the revision of the building code, SBi launched calculation tools that made it possible for the projecting engineer and architect to compare the impacts of different window solutions on the total energy performance of the building[xxx]. A European programme Window Information System, funded by the European Commission, was published in 2004 and enabled the comparison of the optic and thermic qualities of different window components and systems[xxxi].

The revision of the building code in 2006 was originally anticipated to be a great challenge for the window branch[xxxii] and Ehrversbladet and The Danish Construction Association assumed that many of the window types could not live up to the new air tightness requirements[xxxiii]. Closer to the revision date, the further influence of the building regulations on window production was, however, according to Ehvervsbladet, rather unclear, as the requirements could also be achieved by using other architectonical solutions[xxxiv]. The media, however, came to link the building regulation revision with the achievement of energy efficiency innovations in the branch. Ingeniøren, Arkitekten and Storke Vinduer stated in Byggeriet that the revision had lead to window innovations or interest in developing more energy efficient windows[xxxv]. Furthermore, Storke Vinduer articulated the building code to be a major supportive element for the clients' willingness to pay more for the best energy class window solutions[xxxvi].

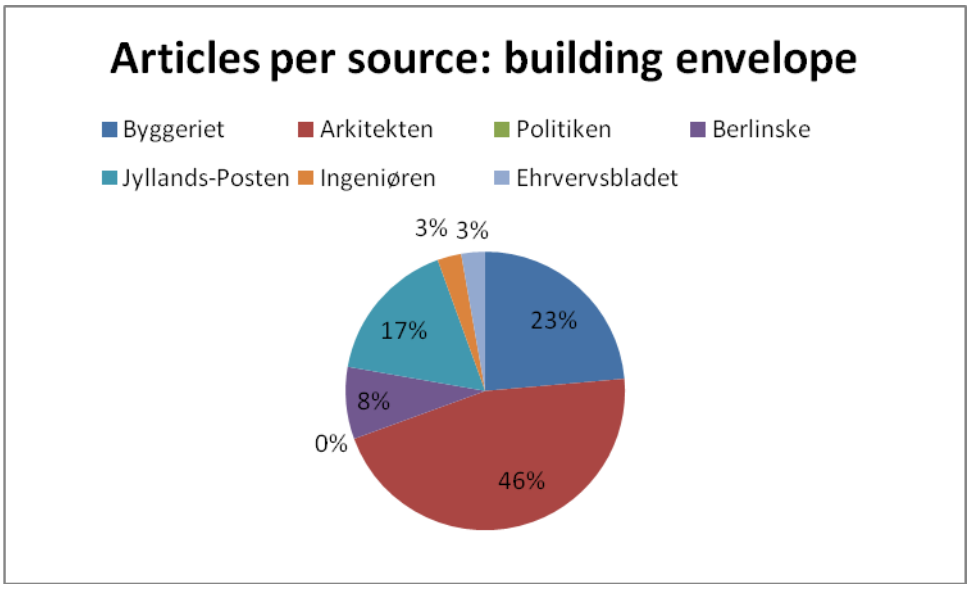
The media does not discuss to what extent the leakages of warm air through air bridges in window frames has been solved thanks to the new window frames and the network supporting their stabilization. However, the networks that strengthen or challenge the production and use of energy efficient window solutions were discussed to a certain extent – but only in relation to building renovation. Regarding window renovations several issues were brought up[xxxvii].

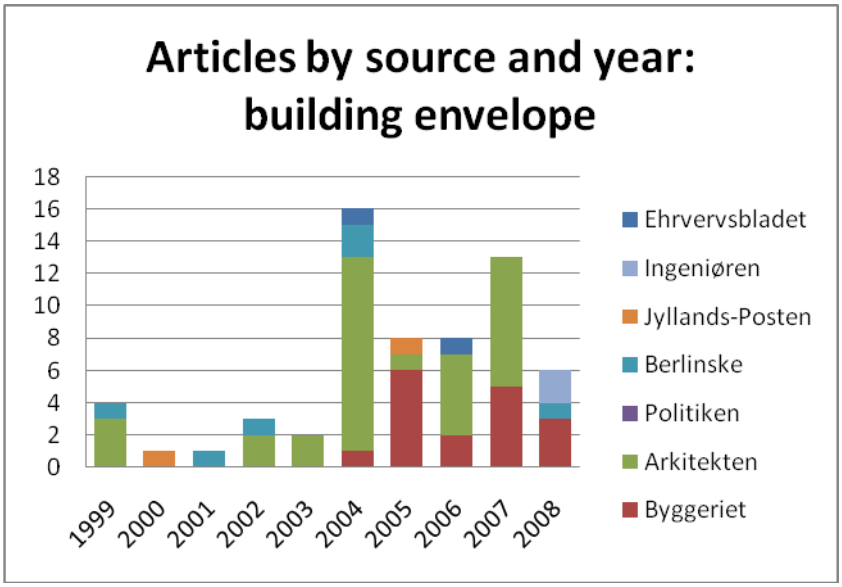
First, the competencies of the building sector were expressed as inadequate in the field of energy renovation of exiting buildings[xxxviii]. Second, package solutions that would integrate energy renovation to other types of retrofitting were not offered by the industry[xxxix]. Third, in Byggeriet and Politiken, it was also possible to identify articulated adverse impacts for the building owner in the case the energy efficient option was chosen. According to SBi, the house owners were more likely to opt for changes that made a difference in aesthetic terms than in terms of energy efficiency. The price of enhancing energy efficiency juxtaposed this measure with other house improvement measures. However, would the windows be changed in the first place, this could be done with keeping energy efficiency in mind[xl]. In respect to public

buildings, changing windows, amongst other energy efficiency measures, was often not carried out as the one time costs for this could not be accommodated in the budget even though savings in the long run were clearly visible[xli]. Finally, in Politiken, the Ecocouncil pointed out that the present taxation system created a barrier for the building owner for retrofitting windows as this was categorized as an improvement in the building and thus lead to a higher taxation value[xlii].

Energy savings and the building envelope

Energy efficiency related to aspects around the building envelope, walls, roof and fundament, was one of the most discussed themes under the banner of energy efficiency in buildings. Byggeriet and Arkitekten were the most active media in publishing articles on this issue 17 and 33 articles respectively. In addition, some articles were also published in Ingeniøren, Ehrvervsbladet and daily news papers Politiken, Berlinske Tidende and Jyllands-Posten. The publication activity in this area was most active in 2004-2007. This can be partly explained by the inclusion of Byggeriet in the data sample in 2003. However, at this point in time, also the daily media and Arkitekten became more active.





In the articles, two main areas of energy efficiency were discussed: insulation and air tightness. While energy efficient houses were ideally framed as well insulated and air tight, these two aspects were also problematized. In the following, I will discuss the media coverage on these two dimensions of energy savings in the building envelope, air tightness and insulation.

Air bridges

The media paints a picture where air bridges were an issue discussed already before 1999 when the first reference to this occurs in the media material used in this research. A number of articles across all media refer to problems in air tightness in new Danish buildings. In the media, a number of actors participate in articulation of these concerns, including firms (Dansk Bygningsundersøgelse)[xliii], the Danish Energy Agency, Danish Building industry[xliv] and Building Envelope Association (Forening Klimaskærm)[xlv]. The Danish Energy Agency, for example, stated that data on untight buildings had led them to allocate the municipalities a responsibility for testing the air tightness in at least 5% of the new buildings[xlvi].

In the media two issues making the leakages of warm air possible are named: untight building elements and unskilled or disinterested professionals working in the construction industry. The building elements allowing for leakages are mainly present through demonstrating technological solutions to this problem. The technological solutions include new ways of fitting together the fundament elements[xlvii] and insulation products with less air bridges[xlviii]. The possibilities to control the leakages in this manner are not discussed after 2003.

On the other hand, engineers, architects and building site workers were not necessarily easy to mobilise to build, design and draw tight houses. Reduction of air bridges was not only possible with new products and construction details, but was to a large extent seen to be dependent on the skills and interest of the

professionals in projecting and building through. From 2005 onwards, change in work practices of architects, projecting engineers and building site workers was called for both in Arkitekten[xlix], Byggeriet[l] and the Building Envelope Association in Ingeniøren[li] and Danish Building Industry in Berlinske Tidende[lii].

In close connection to the new building code in 2006, tools for calculating energy efficiency of different building elements, including insulation and energy tightness of the building elements, their linkages and methods to visualise these, started to appear. Tools for calculating the energy performance of a building were partly produced by SBi[liii] and partly by building product producers, such as Leca[liv]. Furthermore, the air tightness of the building could be visualized with a help of a Blow door test which was based on pressure, smoke and thermo graphing of the existing building[lv]. These tools could be seen as an attempt to equip the engineers, architects and workers in a way that makes it easier for them to design, calculate and construct air tight houses.

While the leaking heat was problematic for energy efficiency, enhanced air tightness as a solution to this was articulated as not being totally unproblematic either. Some traces of problematization of air tightness were brought in by few articles with a reference to in-house climate and electricity-use. In Arkitekten, the supporters of passive house concept, for example, had encountered suspicion in relation to the in house air quality. The cure for a possibly closed indoor air quality was, according to the passive house supporters, mechanical change of air in the buildings[lvi]. Mechanical ventilation was, however, seen problematic from another point of view: increased use of electricity – a trend that was further strengthened by air exchangers with an inbuilt heat recovery heat pump. As the Danish electricity is to a high degree produced in combined heat and electricity plants, the increase in electricity use would lead to excess in produced heat[lvii]. Here, maintaining energy efficiency while neutralizing the problematic concern (bad indoor climate) by a new technology (mechanical ventilation) would create another problem that might undermine the energy efficiency impact of enhanced air tightness in buildings – and that of the Danish society.

Leakages and heat transmission through insulation

Another problem that was reported to challenge energy efficiency was that of heat escaping through building components and eventually through thin layers of insulation. In the media, poor insulation of the majority of existing dwellings in Denmark was seen as a major factor contributing to the low energy efficiency of the existing building stock. Furthermore, insulation of new buildings was also named as one of the ways to increase energy savings in buildings. Of the Danish media Arkitekten was the most active in this discussion, but the problems and solutions reflected in Arkitekten were also shared by Byggeriet.

Increasing insulation was articulated as a means to block the leakage of warm air form spoiling the energy efficiency. However, in regard to existing buildings, two issues created difficulties in the case of retrofitting insulation: economic and aesthetic concerns. In relation to new buildings, increasing the level of insulation was mostly problematized with aesthetic arguments and to some degree with the disappearance of the Danish brick building tradition. Traditional brick building techniques were seen as incompatible with high

levels of insulation. On the other hand, it was also stated that the benefits of further insulation were marginal as long as the buildings were not tight[lviii].

The plans to revise the Building Code brought up some discussion on the experienced consequences of the increase in insulation thickness in new buildings after the earlier revisions in 1995 and 1998. The up-coming revision of building regulations (2006) was by some seen as either a compulsory increase in insulation or leading to increase in insulation[lix]. In some articles, architects linked thicker insulation to 'guglhus' architecture: thick walls, small windows and little light inside the house[lx]. Aesthetic qualities of the building were articulated as further concerns when using thicker insulation. However, already in the late 1990s, DTU carried out research on increasing insulation efficiency without increasing the thickness of the insulation material[lxi]. Two new products introduced in 2006, Rockwool's HardRock Energy and Rockwool underlay board enabled a higher insulation effect for a given product thickness[lxii]. By increasing the insulation effect per used centimetre, extra insulation would not necessarily mean thicker walls and loss of light.

The legitimacy of the accusation of building regulations leading to thicker insulation and walls and deeper buildings was, however, questioned by demonstrations of how to meet the energy efficiency requirements by creatively juggling the different elements related to the energy performance of the building: insulation in different parts of the building, better windows, air tightness, use of passive solar power, minimizing the need for cooling and the need for artificial lighting. This juggling was allowed by the principle of freedom of method for achieving a given energy performance level introduced in the building code revision in 2006[lxiii]. Overlapping with the launched of the revised building code in 2006, both SBi and insulation producers such as Rockwool and Isover were mentioned to have developed tools according to which it was possible to both assess the relative energy saving effect of a particular insulation solution and its effect in relation to other energy saving solutions, e.g. enhancing the energy performance of windows versus the air tightness of the building[lxiv]. When approached through the freedom of method, the above mentioned aesthetic concerns related to enhanced insulation could not necessarily be realized as the insulation would be placed in the fundaments and roof instead of walls. Alternatively, the needed energy savings could also be gained through focusing on other dimensions of the same building, for example windows or air bridges. The freedom of method was hereby used to pre-empt the concerns related to the enhanced level of insulation by making the insulation in walls unnecessary.

Another problem articulated in relation to the increasing level of insulation related to the Danish tradition of building with bricks, which was seen to be endangered as bricks would take too much space in the complex facades with the required thick insulation layers[lxv]. An answer to this problem was presented in Byggeriet. A new brick product, Wienerberg's T8 Portherm, presented in Byggeriet in 2008 featured a brick with inbuilt insulation. According to Wienerberg this product made it possible to build a monowall as no other insulation was needed[lxvi]. A similar product was mentioned in Berlinske Tidende in 2001[lxvii].

In regard to existing buildings, dealing with the heat leakages by enhancing insulation level was problematized in two ways: aesthetic and economic. The aesthetic concerns were not widely discussed in

the media yet the issue was mentioned as a new insulation product, Rockidans Capec System, was presented in Arkitekten in 2004. This product enabled keeping the facade unchanged[lxviii]. In 2006, another product with a similar non-impact was introduced by Rockwool and presented in the Byggeriet, Flex Systemwall[lxix].

Besides the aesthetic issues, the media also reflected upon the price of the extra insulation as being problematic: the question of increased price was relevant in terms of the prioritisation between energy saving and other qualities of the building by home owners. Research results from the Danish Building Research Institute, for example, showed the interests of the building owners in investing in more visible renovation projects than insulation[lxx]. Money juxtaposed energy efficiency with fancy kitchens and other more visible improvements. Energyconsultants (Energiledelsesordning) also pointed out the consequences for those occupying rental buildings. An investment in insulation would lead to increase in rent[lxxi].

Both Arkitekten and Byggeriet pointed out that this type of prioritization was based on a short term calculation of investment costs. Both Arkitekten and Byggeriet wrote on the total economic benefits of mounting extra insulation: it would pay itself back within a restricted number of years[lxxii]. This was also demonstrated in a presentation of a retrofitting project carried out by DTU-BYG, Rockwool and Danfoss[lxxiii]. DTU-BYG introduced a total economic principle and energy savings price in order to concretizise and optimize the economic savings related to increase of insulation[lxxiv].

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An air tight building with minimal transmission of heat through building components was a stable reference point for the ideal state of affairs in terms of heat maintenance in buildings all through the investigated times span 1998-2008. Air tightness was directly problematized in two occasions where suspicions of indoor climate quality and increased level of electricity use in mechanical ventilation were articulated in Arkitekten. However, four other types of concerns challenged the realization of the ideal state of art: heat loss through windows and the building envelope and heat loss through air bridges in window frames and between the elements of the building envelope. While the heat leakage through window glass gradually disappeared from the media, other concerns prevailed.

Even though the problems in realizing the ideal state of art of heat maintenance seemed to be of rather persistent character, the stability of these problematizations was nevertheless continuously contested by different technical and social solutions to the problem of heat loss. New air tight window frames opened up a possibility to block the heat leakage from happening. The new window frames were backed up by governmentally financed information dissemination campaigns, education of window professionals, energy labelling of window frames – and finally – changes in the Building Code. New air tight building elements and more effective insulation made the reduction of heat loss through the building envelope a possibility. Tools that equipped engineers and architects in the calculation and visualization of the heat loss impact of

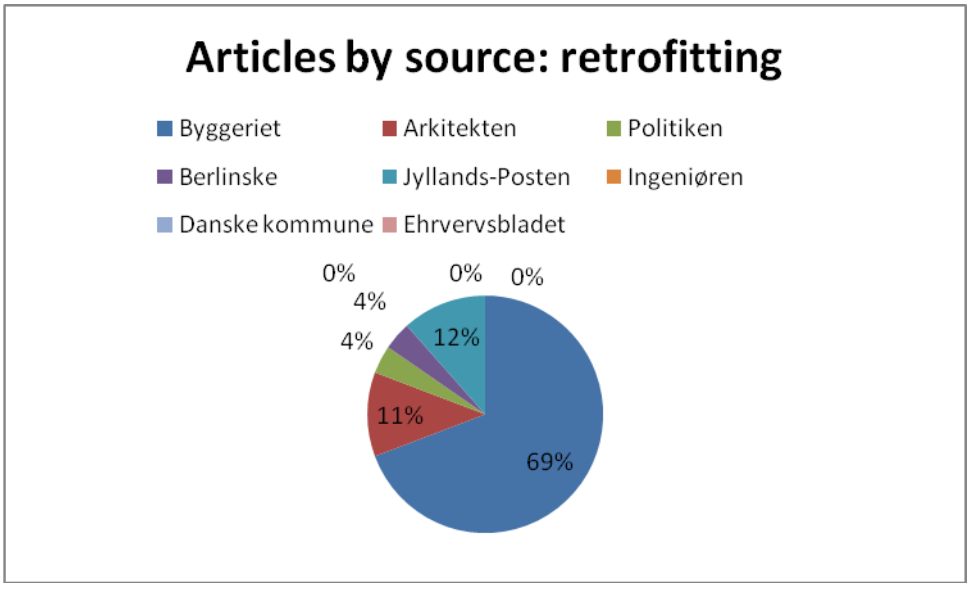
different building elements were launched by public authorities and producers of building products. Yet, no closure to the concerns is articulated in relation to window frames or the building envelope.

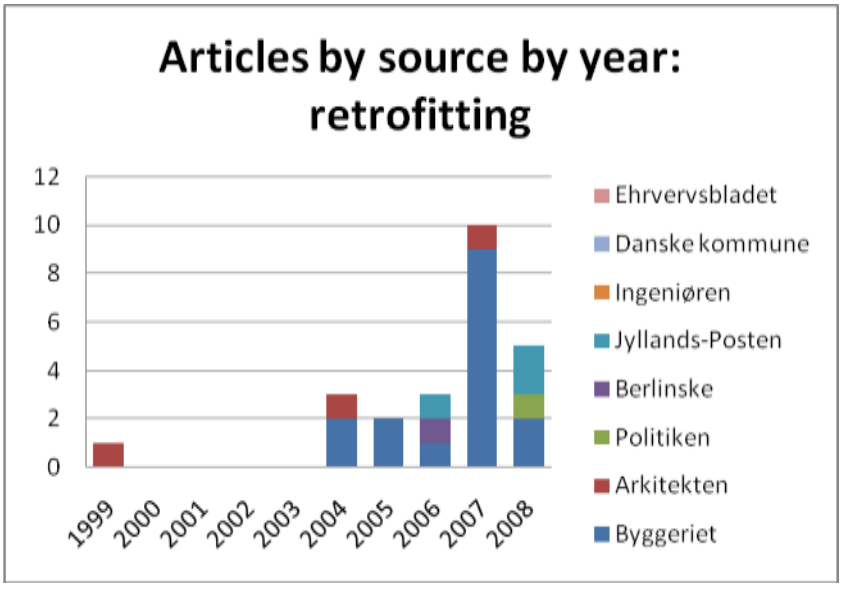
One of the interesting dimensions related to the technological and material solutions that were offered to overcome the heat loss were the concerns related to these very solutions. Energy saving glass, for example, was claimed to change the quality of the day light entering the room. Increasing the level of insulation would lead to thick walls and less day light and even contribute to making the Danish brick building tradition distinct. Thus solving a problem seemed to lead to concerns in other locations.

In general, it seems that the problems related to the solutions to the heat loss problems were mostly discussed in trade off –situations where the solutions created negative impacts in the building itself and its physical or architectural dimensions. However, other trade-offs were also mentioned: 1) trade-offs that were caused by the investments in energy efficient solutions economically restricting the possibilities to carry out other measures either in the building itself or otherwise, 2) energy-efficiency leading to trade-off with production processes or products already in place, 3) energy renovation leading to negative economic sanctions in terms of increased building ownership taxation, and 4) energy efficiency aspirations leading to having to coordinate several different renovation teams in stead of a one do-it-all team in a renovation project. Furthermore, and perhaps most interestingly, reluctance of both house owners and building professionals to opt for the energy saving solutions or action was sometimes simply addressed as 'lack of knowledge', 'disinterest' or 'unwillingness' – if at all. We know for example that campaigns were launched in order to mobilize the window professionals and house owners to use energy efficient window solutions and that there were difficulties in getting engineers, architects and builders to minimize air bridges in the building envelope. Yet the reason for the resistance from their behalf remains undiscussed.

Retrofitting for energy efficiency

Energy savings potential through retrofitting was one of the smaller themes (25 articles) in the Danish media and discussed mostly in Byggeriet and from 2004 onwards.





In some articles it was mentioned that it was precisely the existing building stock that held the greatest energy saving potential in the building sector[lxxv]. Besides saving energy, energy renovation was argued to lead to financial savings for the building owners[lxxvi] as well as reduction of CO2 emissions[lxxvii] and beneficial impact on employment[lxxviii]. Renovation and change of the building envelope, windows and changing the central heating system and mounting a heat pump to the ventilation system were generally seen as the best objects for effectivizing[lxxix]. Furthermore, especially Byggeriet characterizes energy renovation as a great market opportunity[lxxx].

Despite the great potential, however, Byggeriet and Jyllands-Posten explicitly state that energy renovation of existing building stock has not proceeded in the recent year and the political visions for the area have

not been met[lxxxi]. Jyllands-Posten also denotes to a tension related to the level of ambition in the building code. As a response to the plans on the renewal of the building code, profitability of the energy renovation was addressed by the Danish Construction Industry and House-owners Association. This led to making the energy renovation of existing building stock for which general renovation was planned compulsory only when the energy renovation would be financially profitable[lxxxii].

The main issues mentioned in regard to retrofitting were the energy and financial savings potential and barriers and incentives for enhancing energy efficiency in this area. In the following section I will present the barriers and solutions as mentioned in the media regarding carrying out energy efficient retrofitting in a larger scale. Besides the barriers, a number of energy renovation products and projects were brought up mostly by Arkitekten and Byggeriet[lxxxiii]. A more thorough discussion on these products and the opportunities and problems related to these is presented in the previous and following subchapters.

Barriers and opportunities

Several barriers and development areas were mentioned in the media part of them relating to the building owners and part relating to the construction workers. Regarding the building owners, it was stated that there was very little interest for energy renovation from the customer side[lxxxiv]; house owners were more interested in more visible renovation projects[lxxxv] and did not use tools such as the energy label owners in energy renovation[lxxxvi]. In addition, energy effectivizing was claimed to be more difficult than necessary due to the lack of customer friendly integrated and customized building renovation solutions that include energy renovation[lxxxvii].

Financial barriers and negative incentives were many. The media reported a lack of financing forms that recognize the long term savings related to energy renovation[lxxxviii]. Rental legislation, real estate taxation and the use of brutto and netto areals got also mentioned as negative financial incentives for energy renovation[lxxxix]. The start up financial costs of energy renovations might also increase rent levels[xc]. As for the public building owners, the budget structure that does not acknowledge long term savings and budgetary constraints were mentioned as one of the barriers for energy renovations[xci]. Here, the construction industry expressed a wish that the public building owners would take a lead and look actively into the energy efficient retrofitting[xcii].

Construction entrepreneurs were claimed no to have the necessary know how and competencies[xciii] in energy efficient refurbishing. Easier access for the professionals and the building owners to information on energy optimatization as well as education were called for[xciv]. Knowledge of and ability were seen as an essential area of development, including the above mentioned package solutions for renovation[xcv].

The barriers mentioned by the Danish media did not gain much further attention. However, Byggeriet does report on some attempts to define and overcome the hurdles. One of these is an initiative from behalf of

the Danish Construction Industry who tries to bring together relevant and interested enterprises in a network where barriers for market development for energy efficiency projects could be discussed[xcvi]. Through a multiparty contract in 2008, also the Danish Government seeks to work with some of the issues stopping energy renovation from taking place. Also new governmental initiatives including reassessment and the potential renewal of the energy label system and energy saving companies (ESCOs) were investigated by the government[xcvii].

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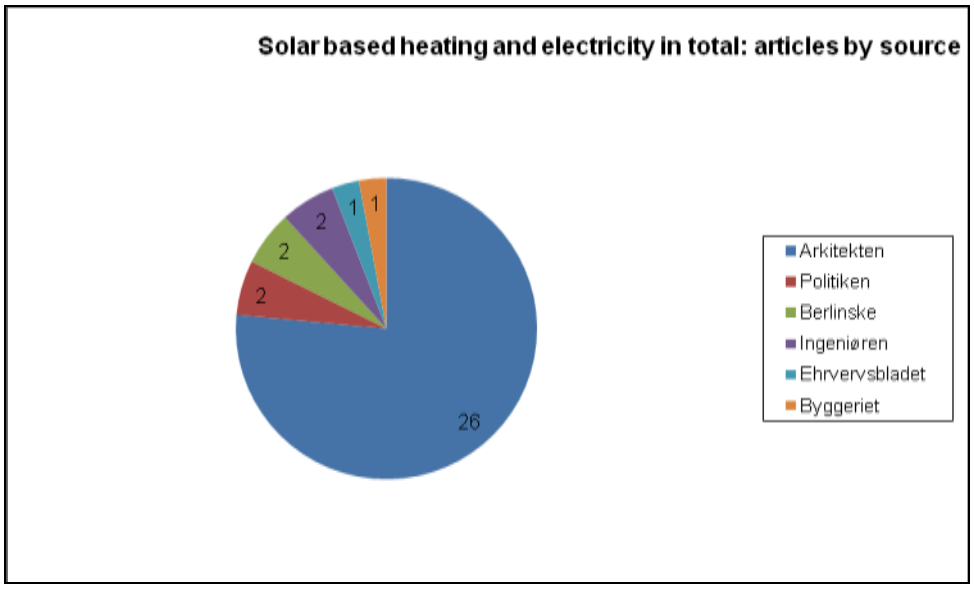
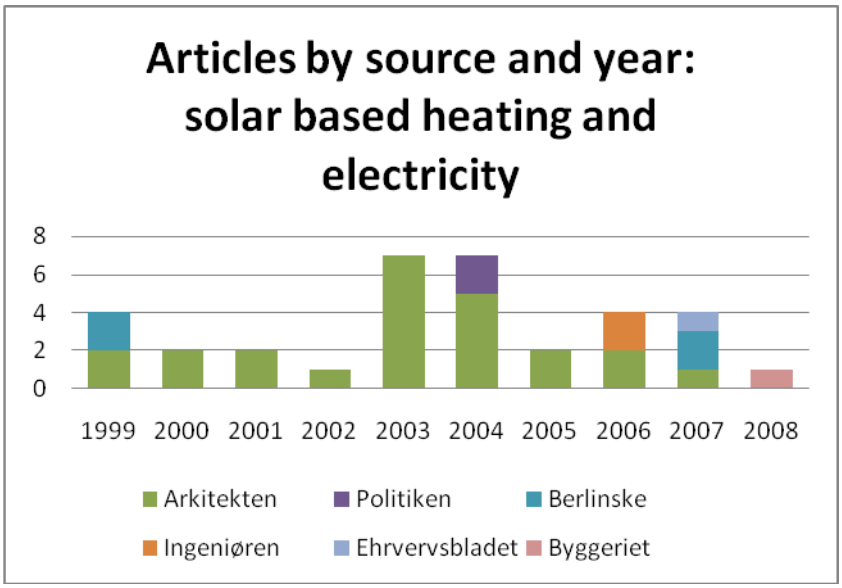
Energy efficiency in retrofitting seems to have taken off as a discussion topic first after 2004. Furthermore, it is a topic that was not actively discussed across the media. The integration of energy efficiency concerns into retrofitting was seen as insufficient, yet no through discussion about the reasons or solutions for this was taken. The government, building sector and the academia brought up their ideas for how the integration of energy concerns best could be improved in retrofitting but the implementation of these ideas was not followed up. Financial and information based barriers and opportunities were the most prominently mentioned issues yet they never evoke the same amount of interest as the technical and material problems and solutions presented in the previous subchapter on windows and insulation.

Solar based heating and electricity

In the Danish media, both solar based heat production for warm water and heating and electricity were discussed frequently albeit not very actively since 1999. The main themes covered were passive solar gain (10 articles), solar panels for water and air heating (12 articles) and photovoltaic solar systems (electricity, 12 articles).



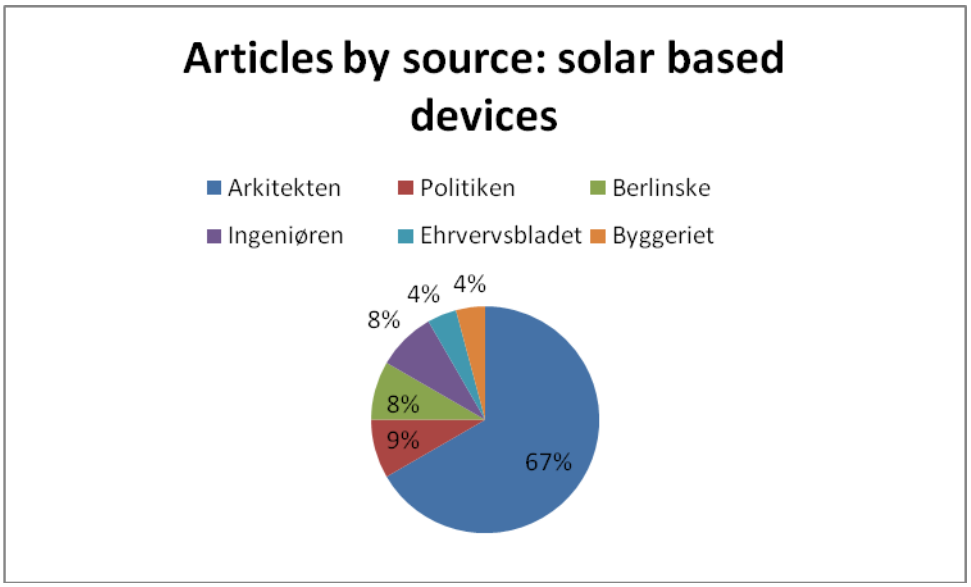
Solar based heating and electricity were mainly discussed in Arkitekten. The discussion was at best only seven articles a year but the theme appeared in the media frequently through the whole time span of this investigation.



In the following, I will first discuss the media coverage on solar based technical devices solar panels for water and air heating and photovoltaic solar systems and second the use of passive solar power.

Solar based heating and electricity devices

Solar cell technology for electricity production was seen as an interesting option for bringing down the use of electricity from fossil sources through building integrated elements[xcviii]. The technological feasibility of the photovoltaic systems was demonstrated in several articles by Arkitekten during 1998-2006 on several different products and building projects using solar cells[xcix]. In 2006-07, also solar based water and room heating was articulated as an economically beneficial and technologically viable option[c]. Besides presenting new products[ci] and demonstration and research projects on building integrated solutions[cii], the media writings focused mainly on two topics: price and aesthetics. These will be investigated in the following. The discussion was mostly carried out in Arkitekten which was practically the only media discussing the question of aesthetics in solar based heating and electricity devices.



Price

Several articles mentioned the price of solar cells as problematic: the price of electricity produced by solar cells was remarkably higher than that of conventional electricity[ciii]. Therefore, bringing down the price was seen as essential for the market development of solar cell devices[civ]. In the media several issues were mentioned that influence the price of solar based technologies: subsidies, oil price, legislation, scarcity of materials[cv] and multifunctionality of solar panels and cells.

In the early 2000 solar based heat systems received state subsidies the value of which was dependent on the performance of the device[cvi]. The subsidy, however, was removed when the new government started in 2003[cvii] which – given EU's work on revision of energy labelling - was seen as odd by Arkitekten[cviii]. In the beginning, the removal of the subsidy was mentioned as having negatively influenced the sales of solar based electricity and heating devices[cix]. Despite the removal of the subsidies, however, in 2006-07, daily newspapers wrote of the rapidly increasing sales of solar based thermic devices[cx]. Also, according to Arkitekten the demand for electricity producing solar cells increased by 40% annually[cxi]. The reason for this

rapid growth was, according to the media, the soaring oil prices and the inclusion of the solar power in the new EU and Danish building code as compensating for energy use[cxii]. In Politiken, an entrepreneur even stated that rather than receiving subsidies they would much rather see solar power as a legal requirement in new buildings[cxiii].

The price of solar based photovoltaic and heating devices could also be influenced by their possible multifunctionality. If solar based devices could functions as integrated and multifunctional parts of the facade substituting traditional façade materials, insulation or other energy effectivizing solutions, solar cells and panels could be seen as economically viable[cxiv]. When the use of solar energy for electricity would be calculated in the total energy use of the building, use of solar cells might not only become attractive as a means for bringing down the need for other façade materials or extra insulation but also the need for other solutions for energy efficiency. Furthermore, integrated systems were argued to yield other benefits as well including architecturally intresting glass solutions, aesthetic improvements of the facade, function as shading, and so forth[cxv]. Integration of solar power elements required, however, development of flexible and aesthetic solar cell products that could substitute conventional facade materials which were demonstrated or mentioned in several articles in Arkitekten[cxvi].

Aesthetics

In several occasions Arkitekten writes about the aesthetic problems and possibilities related to solar cells. Arkitekten mentions that many of the demonstration projects and earlier solar cell products had a peculiar and not always successful aesthetic character[cxvii]. However, Arkitekten also wrote about products that make better visual integration possible[cxviii]. Solar cells could for example be used in windows[cxix], roof and walls[cxx] without them acquiring a dominant visual role. This would enable using solar cells as integrated multifunctional facade elements as mentioned above. Besides flexibility and multifunctionality developing the visual aspects was seen as essential for the viability of solar cell market development as facade material[cxxi]. According to Arkitekten, this required that architects would be willing to participate in cross-diciplinary product development[cxxii].

On the other hand, solar cells could also be used as independent visual elements in the facade. This required that they would be taken into the projects on their own premises and they would not necessarily need to remind of the conventional building materials in their visual expression[cxxiii]. An example mentioned by Arkitekten was a mobile solar panel that shaded for direct sun light yet let filtered sun light enter the building[cxxiv].

Use of passive solar power

The power of sun can be used in heating through solar thermic devices and by optimizing the use of passive solar power by orienting the house and the windows in relation to the sun. In Arkitekten, the only media that discussed solar gain, the use of passive solar power for heating was mainly debated as for its negative impacts based on experiences made in already constructed buildings. The main problems were the

unexpected overheating effects and increasing demand for electricity for lighting in the northern side of the building. Furthermore, a rapport ' Passiv solvarme i nyere danske boligbebyggelser erfaringsopsamling og anbefaling' from the Danish Center for Ecology in Towns (Dansk center for byøkologi) stated that the houses built for using passive solar power had higher or similar energy use as the traditional buildings. The reason for this was mentioned being the lacking skills of the Danish architects, engineers and entrepreneurs[cxxv].

Excessive heat gain through windows during summer months was seen as one of the main problems[cxxvi]. This could lead to increased energy consumption in cooling and air conditioning technologies. This was relevant both for houses with glass facades and buildings the windows area of which was oriented towards sun in order to secure maximum use of passive solar power for heating purposes. The heat gain factor was further emphasized by a new building code that not only calculated the energy needed for heating but also the energy needed for cooling the building in case overheating resulted from excessive solar heat gain[cxxvii].

According to SBi, the energy saving glass types, did not perform very well in relation to reduction of heat gain – they were basically designed to maximize the heat gain[cxxviii]. However, in order to protect the building from excessive heat gain a glass type was developed that reduced the heat gain from sun. Arkitekten mentioned this product already in 1999. Pilkington's electro coating enabled even the switching on and off the reduction of heat gain function in the window according to the amount of sun[cxxix]. However, the glass filtering the sun light and warmth also colored the day light entering the room[1]. Reduction of heat gain also reduced the transmittance of day light. Therefore, Arkitekten proposed more traditional external sun light shading which was admitted sometimes to be difficult to match the simple and streamlined facades[cxxx].

Another problem linked to orienting the window areal of the building towards the sun was caused by the increase of the need for electric lighting in the northernmost areas of the building as most of the window area would be allocated towards south[cxxxi]. The use of electricity for lighting was reportedly becoming problematic as the new Building Code from 2006 included the use of electricity for lighting in the total energy consumption calculations of buildings. Lighting was thus made part of the 'official' energy economy of the building[cxxxii].

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The most discussed themes around solar based heating and electricity systems were price and aesthetics. Arkitekten dominated the discussions especially in relation to solar gain and the aesthetic consequences of solar heating and electricity producing devices.

[1] In a pilot project by By og Byg in 2003, the heat gain reducing glass types, however, were not rated well by office workers as they coloured the light that entered the room (Jørgen Hegner Christiansen. Solafskærming., Arkitekten 26/2000, p. A12)

Price related discussions accelerated after the removal of state subsidies from solar technology featuring several different issues that could be taken into consideration in price calculations. Regarding price, the state subsidies and legislation as well as multifunctionality of subsidies seemed to evoke most writings. This interplay of different issues contributing to the understanding of the price of the solar based devices opens up an interesting question of how the price or value of these products is constructed in the building sector.

In terms of aesthetics, two different orientations towards experienced problems with the aesthetic character of the solar panels and cells were expressed. Visually more conventional products were introduced or called for. However, some articles also proposed placing the novel kind of visuality of the solar based devices in the centre of architectonic work thus reorienting the aesthetics of the architecture.

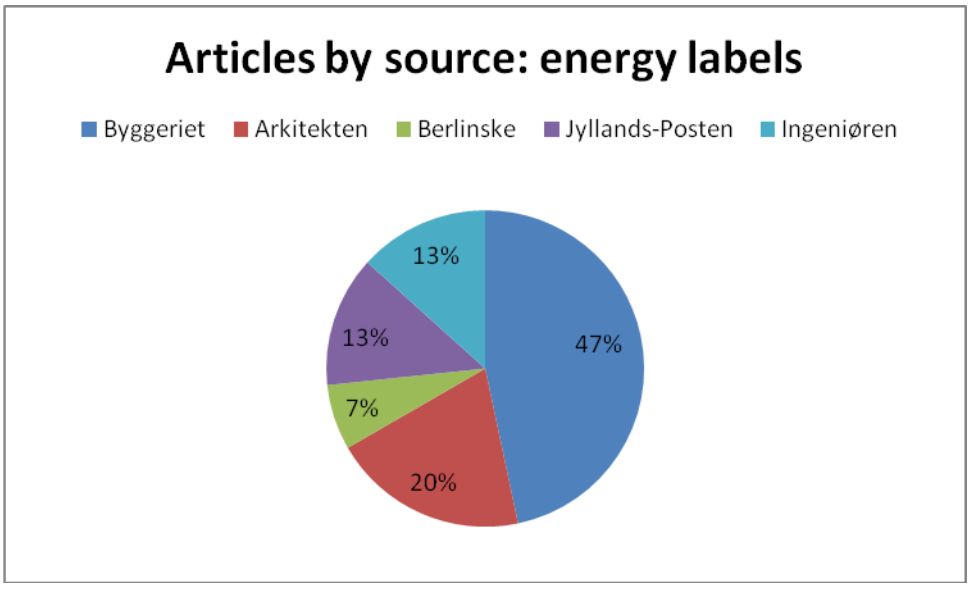
The use of passive solar gain was only discussed in Arkitekten and featured a problem oriented coverage. The media writings revealed tensions between the optimal heat gain in different seasons and optimation of heat gain and light gain. Furthermore, solving overheating problems with multifunctional glass brings about a new area of tension: optimal heat gain and natural light quality. Through these dilemmas, the difficult equation of energy efficiency becomes visible: tensions between different dimensions of energy efficiency on one hand, and tensions between energy efficiency and other qualities of building, on the other hand, show a multifaceted problem field.

ENERGY LABELS AND LOW ENERGY STANDARDS

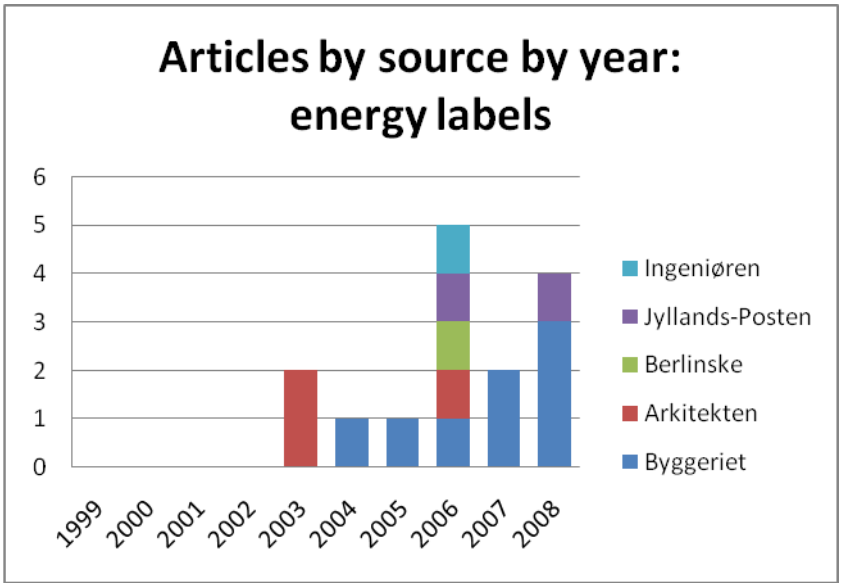
Energy labeling and standardization was one of the areas of discussion in the Danish media[2]. Articles on different energy labels and standards started to appear in the media from 2003 onwards including writings on energy labeling of buildings, low energy classes and the passive house standard. These two themes were covered by many different written media, even though the questions around low energy standards was somewhat dominated by Arkitekten. In the following I will present the main topics covered in the area of standards and labeling.

Energy labeling

Energy labelling of buildings was first introduced to the Danish legislation in 1996 in a form of so called ELO arrangement (in Lov om fremme af energi og vandbesparelser i bygninger). I June 2005 the Danish Parliament approved a law on energy savings in buildings (LOV 585 af 24/06/2005) that included new rules for energy labeling to be enforced by 31. March 2006. In 2006 energy labeling became obligatory for all new buildings, all buildings that were sold and new building attachments. Furthermore, buildings over 1000 m2 (previously over 1500 m2) had to renew their label every five years[cxxxiii]. in 2007, the labeling was also widened to include two low energy standards: low energy class 1and 2, living up to 25% and 50% reduction of energy use in relation to the energy regulations, respectively[cxxxiv]. The renewal of the energy labeling stemmed from a new EU directive on energy labeling of buildings[cxxxv].



[2] Energy labeling and low energy standards are a governmental incentive, stemming from EU legislation while passive house standard is a privately based standard.



Danish media began to discuss energy labelling from 2003 onwards Byggeriet being the most active new media in this respect. Energy labels was not, however, one of the most prominently discussed topics in the field of energy efficiency: only 15 articles were published in six years.

Energy labelling was oriented on one hand towards increasing energy consciousness in house purchasing situations and on the other hand helping the house owners in identifying energy renovation objects. Energy labelling was seen as having a rather limited potential for three reasons: the limited coverage of energy labelling on the other hand and not using the energy label in purchasing or as a tool for carrying out energy renovation of the building.

Before the new energy labelling legislation came into force, only 60% of the sold houses and apartment were energy labelled[cxxxvi]. Even though it became compulsory to label new buildings and those to be sold as well as renew the labelling of buildings larger than 1000 m2 every five years[cxxxvii], this problem was not perceived as solved by all. By energy labelling the new buildings, only 1% of the buildings would get labelled each year[cxxxviii]. Furthermore, even though legally obliged, in 30% of the house sales, energy labels had not been acquired[cxxxix]. Even the Danish state was accused by Dansk Byggeri and Brancheforeningen for Byningssagskyndige og Energikonsulenter for not carrying out the energy labelling it had committed itself to. Government expressed that it planned to postpone the deadline for the energy labelling of state owned buildings[cxl]. In the media, energy labelling of buildings was seen as a possible tool for energy effectivizing of buildings in retrofitting[cxli] when used after buying a house. However, even here, the press stated, many of the house owners that had carried out labelling did not use it to this purpose[cxlii].

Dansk Byggeri stated that the Danish house owners waste several hundreds of Crones annually to carry out energy labelling that was not used[cxliii]. It, furthermore, defines a set of problems related to the energy labelling in its present form: selling being a bad timing for making the energy labelling; unclearness around

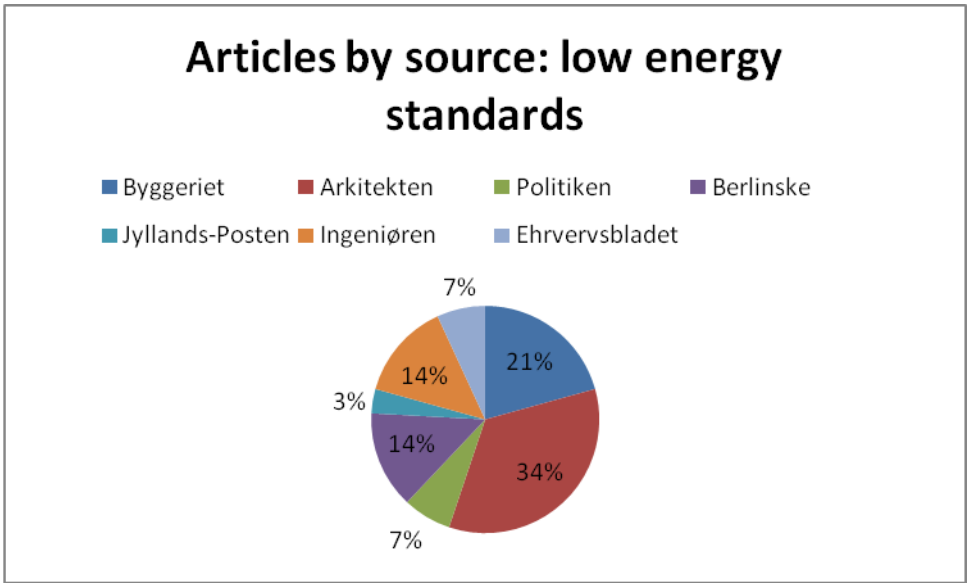
the factual energy use and the calculated energy use that often was somewhat higher than the factual use; uncertainty what was seen as rentable energy renovation, unclear energy declarations, invisibility of the energy labels in the sales materials, inaccessible energy labels[cxliv]. Furthermore, the construction professionals were reported to experience uncertainty in relation to energy labelling requirements and successive control[cxlv].

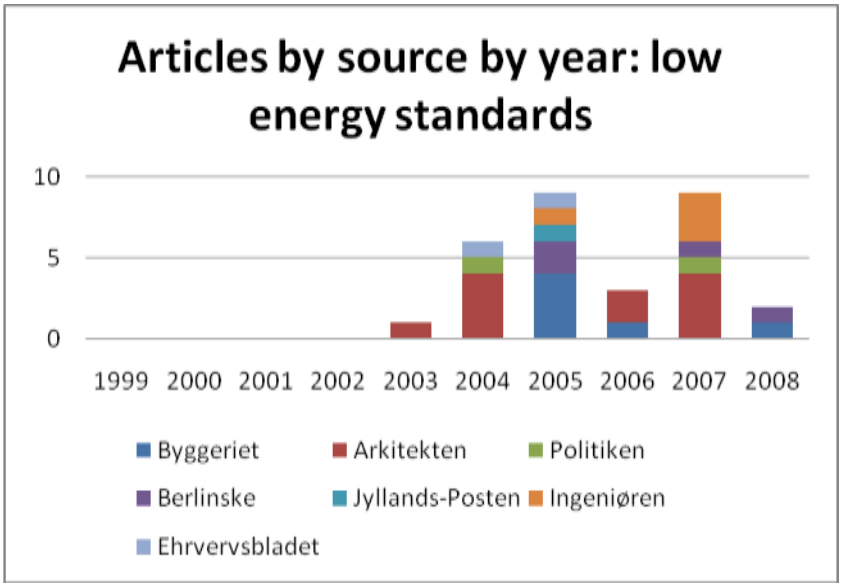
The Danish media reported on some initiative dealing with the problems associated with the energy labelling scheme. In 2004, the Danish Energy Agency launched a campaign for buyers and sellers of smaller houses. Professional workers and entrepreneurs who were seen as playing a key role in informing and educating buyers about the rentable energy efficiency measures in their newly acquired estate. Also Naturgas Midt/Nord and Energi Horsens started a similar project in Jutland). In their common initiative, the industry and academia also proposed that the energy performance of the building should be informed in a simple scale from 1-10, which would improve the energy labelling of buildings[cxlvi]. As a part of a contract between the government and the opposition, the energy labelling model was re-assessed in 2007[cxlvii] and a new model was tested by e.g. Dansk byggeri and several electricity providers[cxlviii].

Low energy standards

Low energy standards 1 and 2 were included in the Danish building regulation in 2006[cxlix] and were to be further strengthened in 2007. However, already before this the Danish media wrote about construction of passive houses which was related to a voluntary German standard on buildings that have a very low need for energy for heating. The Danish Building Research Institute worked to include the passive house standard into the revised building code[cl].

Passive house standard and low energy standards were not based on the same parameters – a passive house focused on energy need for heating while low energy standards calculated the total energy use for the running of the building. Media points out that these two standards, however different, were confused with each other which was suspected to weaken the stricter standard. However, media writings also show that there were different understandings of which of whether the low energy standards could automatically be seen as weaker than the passive house standards[cli].





Low energy standards were discussed from 2004 onwards in many different media. Altogether there 29 articles were published during this six-year period. In the following, I will present three discussion points that engaged the Danish media from 2003 onwards: the feasibility of low energy building and its debated consequences for the economy and quality of construction.

The feasibility of low energy building

The Danish media brings up a number of demonstration projects in Denmark during 2004 and 2008[cliii]. Most of these projects were passive houses and demonstrate that it was possible to build different types of housing, including one family houses and prefabricated houses, in this manner. In Stenløse Syd, a whole town district was planned to be built following in minimum the low energy standards in the building code[cliii]

and in Køge several Swan-labeled houses that live up to the low energy standards in the building code were carried out[cliv]. In 2005, also two totally energy neutral houses were constructed by NCC and Valby solar power group respectively[clv]. NCC stated that a totally energy neutral building was not yet economically feasible. Interestingly, many of the projects were carried out by firms such as NCC, Danhaus, Seest Huse, Hornsherredhus, CasaBo, Lind&Risør, Kant arkitekterne, Harresø Byggeforening and Rockwool. The 'Green house', a clearing house for environment, energy and construction on Sealand, states that market for low energy houses was being created[clvi]. The designers of the swan-labeled houses, however, did not experience interest for the labeled houses[clvii].

Despite the positive stories about the feasibility of low energy houses, the media showed that the energy efficiency of the low energy houses was a contested topic. Investigations in the actual energy use of low energy pilot projects showed in early 2000 that energy use estimates for these projects had been too optimistic[clviii]. Reasons for this ranged from errors in projecting, assessing the technical performance of heatpumps and the higher than expected room temperature[clix]. Interestingly, the technological and material feasibility of low energy building was not contested.

In the realm of projecting and building, a handful of reasons for the failure of the earlier built low energy houses were identified. First, it was claimed that the projecting enterprises had not involved experts in the projects[clx]. Second, in the projecting work two mistakes had been undertaken: opening the windows area towards sun had caused increase in electricity use for lighting on the northern side of the building[clxi] and no shades from surroundings had been taken into account[clxii]. Third, due to imprecise construction work, the buildings were left untight and the heat could leak out[clxiii]. Arkitekten also mentions that one of the problems with the construction work had been the insufficient drying up of the house when taken into use[clxiv]. A handful of articles point out that bringing the energy use down requires cooperation between architects, engineers and those carrying out the construction work in order to find out new solutions[clxv]. However, since the discussion on the difficulties of keeping the energy related goals, Rockwool and Seest Huse have emphasized that today's houses can be built to keep the target values[clxvi]. Interestingly, in regard to passive houses or low energy houses, now discussion about the problems related to passive solar gain was mentioned.

In the Danish media, also several other controversies related to low energy standards were referred to. These controversies relate to the economy of the low energy buildings, energy-use, in-house air quality and aesthetics as discussed I the following.

Economy

The media characterized the running of passive and other low energy houses as remarkably cheaper than traditional houses which made these projects profitable in the long run[clxvii]. One of the related arguments for this kind of housing was independence from energy prices[clxviii]. In 2004, a major Danish bank estimated that that the lower running costs enabled a higher loan investment per m2 for passive houses[clxix]. However,

the building costs for a passive house were estimated to be from 7 to 15% higher than in the normal houses and examples of these were brought from Germany and Austria where passive houses were built in greater amounts[clxx].

The higher start up costs received some attention in the media. According to an article in Arkitekten, building passive houses was expensive, difficult and without profit[clxxi]. Furthermore, due to the higher start up costs, passive house construction was hit hard as the building costs rose in the mid of the first decade of 2000[clxxii]. In addition, it was claimed that it was difficult to acquire realistic price estimates from the construction sector which made it difficult to invest in low energy construction[clxxiii]. However, with the new building regulations from 2006, low energy houses were not any more obliged to join the municipal heat supply system which brought the start up costs down[clxxiv].

In-house air quality

In Arkitekten which was the main media source for this topic, a controversy about the indoor air quality in low energy houses was brought up even though the opinions expressed about this were rather unanimous. Passive houses were claimed to have a good ventilation and indoor air quality even though this had been previously contested[clxxv]. The prejudices about indoor climate were mentioned as one reason for the Danish building sector to have neglected passive house construction. In 2007, a project BOLIG+ aiming for development of energy neutral buildings with healthy indoor climate was launched[clxxvi].

Aesthetics

Arkitekten refers to yet another problem hampering the rise of the low energy buildings: dislike for the window frames available. However, according to architect Ove Langkamp states that in 2007 new thin window frames were available which enabled a new modern look. This offered a new more aesthetic solution than the old passive house window frames but simultaneously challenged the way the Danes had traditionally emphasized the windows by their frames[clxxvii].

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The discussion around energy labels and low energy standards was somewhat different in focus. The energy label was criticized for not being used in the sales situations. Neither did it make building owners carry out energy renovations. This all seems to boil down to the perceived inefficiency of energy labels in making the owners and buyers calculable in terms of energy efficiency. Reasons for this were not discussed in depth – the only reason given was the poor coverage of energy labels before the new legislation.

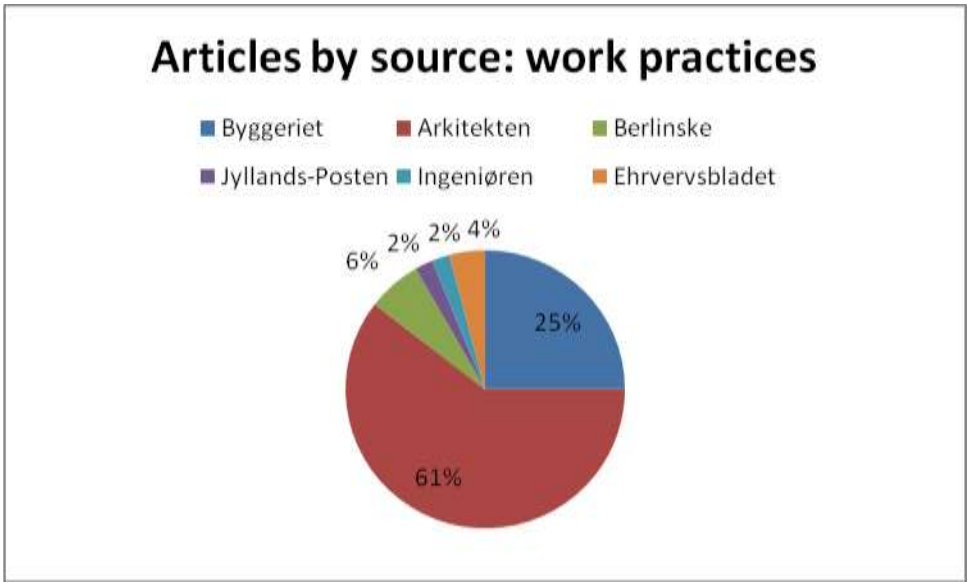
Contrary to the media writing on energy labeling, quite a lot of effort was put into demonstrating that building according to low energy standards was doable. Besides these more optimistic articles, also

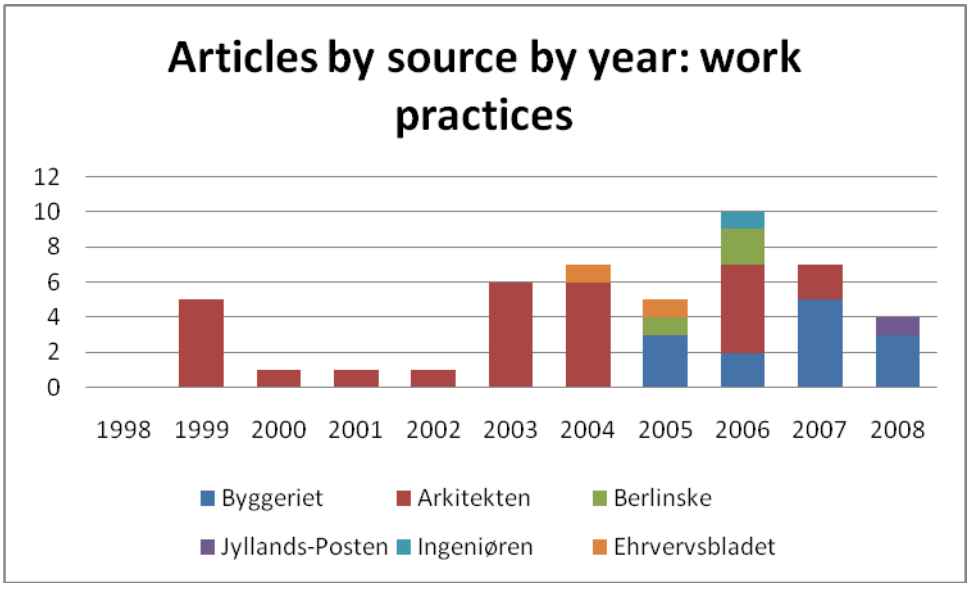
criticism and skepticism was expressed. Media writings addressed questions such as the market value of low energy houses and the economic, aesthetic and indoor air quality of the low energy houses. Both in terms of economy and the architectural and indoor air quality questions the press takes a positive stance. Higher start up costs could be calculated away by using a total economic principle and solutions for both indoor air quality and unaesthetic building elements were reported to be available. Despite the positive orientation, the articles revealed a tension between calculation of long-term and short-term profitability and costs. Furthermore, tensions between aesthetics and air quality and low energy standards were central for the media coverage.

CHANGING WORK PRACTISES

Besides the concrete technical, material and market solutions for energy efficiency in buildings, also work practices through which energy efficiency could be achieved caught some attention in the Danish media. It was stated that in order to bring down the energy use, energy concerns would have to be integrated into the projecting process in the very beginning[clxxviii]. Furthermore, bringing down the energy use requires working with the building as an entity during the projection and design phase rather than working with the energy efficiency of single building elements[clxxix].

The most active newspapers were Arkitekten and Byggeriet. However, other newspapers participated especially by writing about the consequences of the revised building code on the work practices in the construction sector. Again, the years around the revision of the building regulations (2004-2007) were the most active in terms of amounts of articles published.





In the following, I will discuss the media writings on three different topics: integration of energy concerns into work practices in general, the role of the building code's principle of freedom of method in work practices and calculation of energy efficiency and its economic consequences.

Integration of energy efficiency in working practices

The integrated approach to energy economy and taking energy questions into account in an earlier phase was broadly seen as requiring new type of cooperation between architects and engineers and a new kind of intertwinement of the content of their work[clxxx]. For architects this would mean that yet another requirement was enforced which might restrict the creative process. According to Arkitekten, for many architects this was hard to accept[clxxxi]. On the other hand, many articles argue that if the energy or the environmental performance of the building is to be improved, it would be necessary for the architects to step in to provide aesthetic and architectonic solutions[clxxxii]. Besides the enhanced cooperation between architects and engineers, also building site workers would have to change their working practices. Sometimes finding the right solutions requires cooperation at all levels[clxxxiii].

Besides naming what could be done in order to integrate the energy efficiency concerns into projecting practices in an effective manner, some reasons for why this has not happened were mentioned. There were concerns about the indoor climate in the low energy houses[clxxxiv]. Arkitekten refers to yet another problem hampering the rise of the low energy buildings: dislike for the window frames that had been previously available[clxxxv]. Both of these reasons relate to perceived impossibility to combine different visions and requirements for a building.

The ability of architects to design energy efficient buildings was not directly confronted. Arkitekten stated that architects could draw environmentally friendly and energy efficient if this was ordered[clxxxvi]. On the

other hand, some articles brought up the unique competencies that would have to be developed and learned when working with the energy requirements for Swan labelled houses, for example[clxxxvii]. Experiences from unsuccessful low energy houses (see chapter on low energy buildings for more) showed problems both in building orientation, energy balance calculations and construction details. Furthermore, there were calls for examples of how to build more energy efficient and in compliance with the revised building code as well as information of research projects investigating the relations of different building elements to each other when optimizing the energy performance of the building[clxxxviii]. By writing about the bad experiences and new competencies media indirectly participated in forming an understanding of a situation where knowledge and new competencies were needed. Perceived lack of information and knowledge amongst the professionals might in its turn risk the change in working practices.

The revised building code

In the media, the revision of the building code was to a great extent linked to strictening of energy related requirements for building. In many articles, implementation of the renewed and stricter building code has furthermore been named as requiring energy related issues addressed in the early phases of the projecting and – due to the principle of freedom of the method - requiring approaching the energy issues as an aggregate of different elements and requiring new kinds of cooperation between architects and engineers[clxxxix]. Thereby, the new building code could be seen as contributing to the very issues that were generally required for enhancing energy efficiency (as above). However, energy effectivizing in relation to the building code was mostly connected to achieving the set thresholds through the freedom of method rather than achieving the best possible energy efficiency. Thus, the revised building code was simultaneously addressed as something that enhances better and timely coordination of the total energy performance of the building - and superimposes a particular level of improvement.

The need for documenting compliance with the required energy performance of the building[cxc] was brought up in some articles and introduced yet another area of change in the work practices of architects and engineers. In terms of work practises, also the principle of freedom of method in achieving the energy frame for the building was anticipated to bring about changes in work practices, for instance by enabling and enhancing innovation[cxci]. On the other hand, the renewed building code was nevertheless suspected to have led to thicker insulation instead of more creative solutions[cxcii]. Furthermore, an architect raised a concern about the architectonic consequences of stricter energy requirements and earlier involvement of engineers and technical issues in the design process[cxciii].

Calculating energy efficiency

The interest in new types of calculations on the energy performance and financial consequences of different solutions in the Danish media was remarkable. Firms such as Rockwool, Isover and Leca and Danish Energy Savings Fund (Energisparefonden) were reported to have produced tools and programmes for calculating the energy efficiency of different solutions and materials[cxciv]. Furthermore, By & Byg and SBi and the Danish Environment Protection Agency have published assessment tools for calculating the energy

use and other environmental consequences of different materials and construction types (BEAT and BV98, ABC-planer, respectively)[cxcv].

The revision of the building code was clearly seen in the media articles on calculation of energy efficiency. The freedom of method also provoked a number of articles on the principles of calculations. Firstly, there were a number of articles informing about what was counted in the total energy frame of the revised building code and what the thresholds for fulfilling the frame were[cxcvi]. According to Svend Svendsen from the Danish Building Research Institute in Arkitekten[cxcvii]:

'The world of projecting is about to change from dimensioning to optimation'

Furthermore, SBi published calculation programmes and guidance for documenting and ensuring that a projected building will live up to the new energy requirements[cxcviii]. Also Rockwool and Isover developed tools that make it possible to work with different solutions in order to achieve compliance with the building code[cxcix].

Calculations about the energy performance of buildings and solutions were were not the only type of calculations brought up in the media. Also calculations combining economy to energy efficiency were discussed in two interlinked ways. First, Byggeriet reports on a calculation model according to which a building owner constructor can assess the economic consequences of a not carrying out energy refurbishment[cc]. Second, attention was also given to those cases where the profitability of the energy efficiency measures had to be defined. Arkitekten suggested using a principle of total economy or calculating the price of investment against the price of energy savings with a programme Dbuild[cci]. The profitability discussion was also raised in relation to the freedom of method in the revised building code which was anticipated to bring in new complexity to designing sustainably in economic terms[ccii].

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Across the different articles in the Danish media, there was a unity about the need for change in work practices in order to enhance the energy efficiency of the construction sector. Energy issues ought to be integrated into work at an early stage with a focus on the building as an entity rather than with a focus on different building elements as separate. Several articles bring about thoughts about why this change had not happened or would be difficult yet no in depth discussion about change in work practises was taken in or between the articles. Possible problematic areas, such as the inclusion of technical parameters into the creative architectural work and the balancing between the freedom of method and the energy frame, were named. Interestingly, the accepted reasons for problems in changing working practises relate to the reluctance of architects or other building professionals to include energy concerns in their work and beliefs

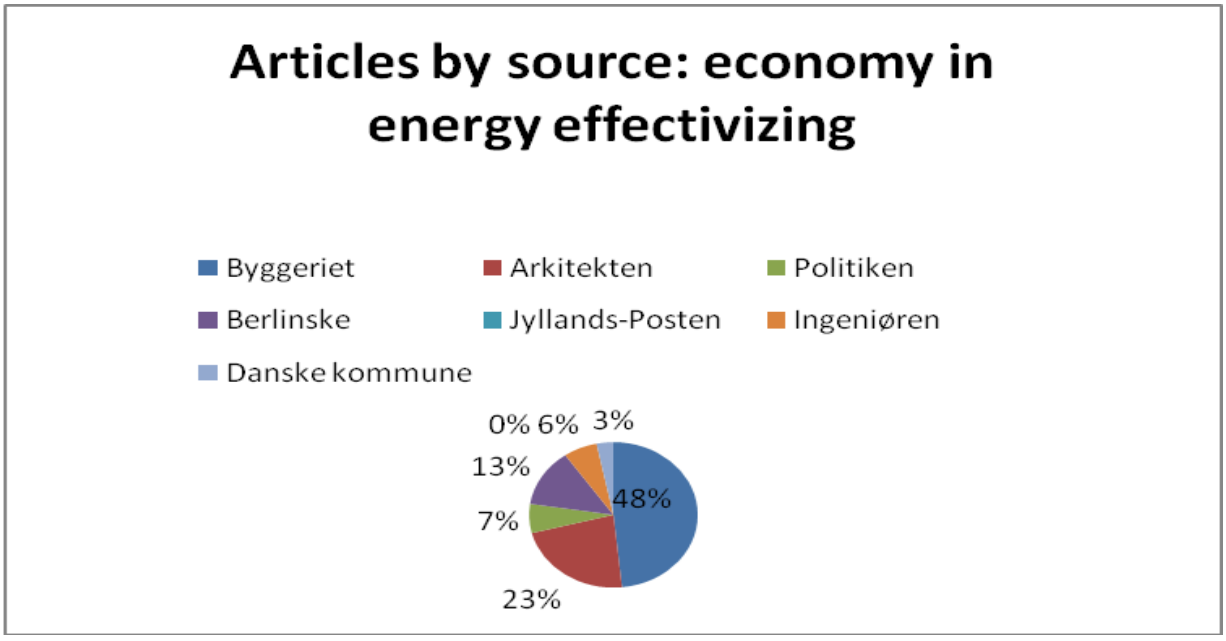
about the aesthetic and health related quality of low energy buildings. Between the lines, however, also issues such as knowledge, skills and economy are discussed.

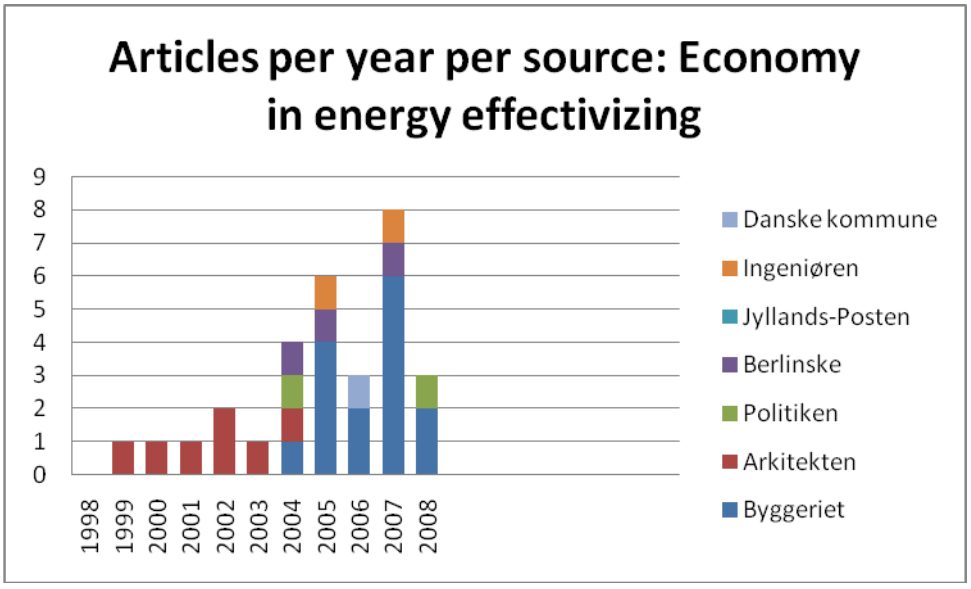
The revision of the building regulation was expressed as playing a potentially great role in changing the building practises and the majority of media coverage under this theme occurs around the time for either revision plans or on revision itself. While the positive impact on energy efficiency of the Building Code was broadly agreed upon, the writings of the media emphasized tools and practices as for something assisting in living up to the legal requirements but did not talk of them as enhancing energy efficiency beyond that. Several tensions could be seen in the media writings on the revised Building Code. On one hand, the Cuilding Code was believed to enhance innovation, on the other concerns about the architectural quality of buildings and focus on technicalities were expressed. The freedom of method principle in the Building Code was discussed both as enabling energy efficiency and challenging for the professionals who had to find the way to optimize each single building. Finally, the writings of the building code featured construction as a calculative and documentative praxis.

ECONOMY OF ENERGY EFFICIENCY

A number of different elements influencing the economy in energy effectivizing were brought up in the Danish media including tackling the higher up-front investment of energy effetivizing and issues affecting the long term profitability of energy effectivizing. Economy has been one of the most prominently mentioned themes in articles dealing with energy efficiency in construction be it retrofitting, insulation or energy labeling. In the following I will present the main thematics related to economic issues in energy efficiency in construction including economic potential of energy savings, financing and dealing with higher start up costs of energy efficient housing and technologies and other issues influencing the economic profitability of energy saving measures.

The economic issues were discussed in many different media, but the majority of articles in this area were published by Byggeriet. From 2004, economic issues were increasingly discussed from 2004 onwards where the amount of participants also increased. Before 2004, the area was only covered by Arkitekten. In the articles, two main areas of energy efficiency were discussed: insulation and air tightness.





The economy of energy effectivizing

The up-front investments for many energy effectivizing solutions were estimated as high[cciii]. For example the building costs for low energy or passive houses were estimated to be from 7 to 15% higher than in the normal houses and examples of this were brought from Germany and Austria where passive houses were built in greater amounts[cciv]. The running of passive and energy efficient houses, however, was described as remarkably cheaper than traditional houses which would make these projects profitable in the long run[ccv].

The high start-up investment seemed to have frightened both the private and public building owners and entrepreneurs[ccvi]. According to an article in Arkitekten, for example, building passive houses was expensive, difficult and without profit[ccvii]. Indeed, due to the higher start up costs, passive house construction was hit hard as the building costs rose in the middle of the first decade of 2000[ccviii]. An interesting example from a low-energy area in Stenløse shows that the start up costs might even get higher than anticipated based on the costs of energy saving measures alone: a gas provider demanded a higher start-fee based on the lower future use of energy[ccix]. On the other hand, due to the new building regulations from 2006, low energy houses were not any more obliged to join the municipal heat supply system which brought the start up costs down [ccx]. In relation to public buildings, Byggeriet mentions the dilemma of the municipalities as being that of the budgeting practice: economic savings in coming years would not easily be combinable with an annual budget cycle[ccxi].

Both Arkitekten and Byggeriet have written about financing the higher up-front costs. Even though the savings stemming from energy saving measures were seen to enable a greater investment[ccxii], the mortgage praxis of financing institutions does not take this into account in estimating the pay-back potential. Therefore, access to loans for energy effectivizing measures was limited[ccxiii] and the pay-back time was not related to the tempo through which the savings took place[ccxiv]. A change in the mortgage practice was advocated by many organizations including the Architects' Association of Denmark (Akademisk

arkitektforening), Danish Association of Construction Clients (Bygherreforening), Danish Industry (byggematerialeindustrien/Dansk industry), Danish Construction Association, the Danish Association of Consulting Enginners (Foreningen af Rådgivende ingeniører), the Danish Association of Architectural Firms (Praktiserende arkitekters råd), the Danish Association for installators (Tekniq – installatørers organization), SBi, the Technnical university of Denmark (Byg DTU), The Danish Technology Institute (TI/ byggeri)[ccxv]. ESCO, energy saving company business model, was also mentioned in Byggeriet as a solution for dealing with the higher start up costs[ccxvi]. ESCO-model takes the up-front investment costs from the building owner while the investments are paid from the resulting energy savings.

High up-front costs could also be cut through using subsidies, the media argued. In the early 2000, Arkitekten reports on some programme funds for ecological building from the government[ccxvii] (UVE and SOL1000)[ccxviii]. The extra funding for solar panels was removed soon there after when the government changed[ccxix]. In 2004, Architects' Association of Denmark, Danish Association of Construction Clients, Danish Industry, Danish Construction Association, the Danish Association of Consulting Enginners, the Danish Association of Architectural Firms, the Danish Association for installators, SBi, the Technnical university of Denmark (Byg DTU), The Danish Technology Institute called for a heat saving fund, which has not yet been established[ccxx]. In 2007, while writing of the success of Austria in building low energy houses, Ingeniøren reports that the Danish government parties were not willing to subsidize energy renovation work as suggested by the Socialist People's Party (SF)[ccxxi].

A number of issues that might influence the long term profitability of energy saving measures were mentioned in Byggeriet and Arkitekten. Obviously, the price of energy has had a major impact on the profitability of energy saving measures[ccxxii]. Furthermore, three governmental incentives were seen to hamper the increase of energy efficiency work including real estate taxation[ccxxiii], rental legislation[ccxxiv] and use of brutto and netto areals[ccxxv] Property taxation formed a negative incentive as the tax posed on estates would rise when the value of the buuilding was enhanced. On the other hand, also two governmental initiatives that would improve the long term profitability of energy effectivizing were mentioned in Byggeriet. Denmark, like Germany could grant loans taken for this purpose right for interest deduction[ccxxvi]. Also, Byggeriet wrote about government's energy plan that includes positive indirect economic incentives such as energy savings vouchers that can be changed to money at energy providing companies[ccxxvii].

As mentioned before, the role of the public authorities was discussed both in terms of building owner and in terms of creation of economic environment for energy saving measures. In terms of being a building owner, the public authorities were criticised for not taking the lead[ccxxviii] – even though also positive examples were presented. In terms of creation of a favourable economic environment, criticism was mostly expressed after the change of political power and the removal of subsidies. Denmark was featured as a country once favourable for low-energy construction now lacking long behind of the leading countries, such as Germany and Austria[ccxxix].

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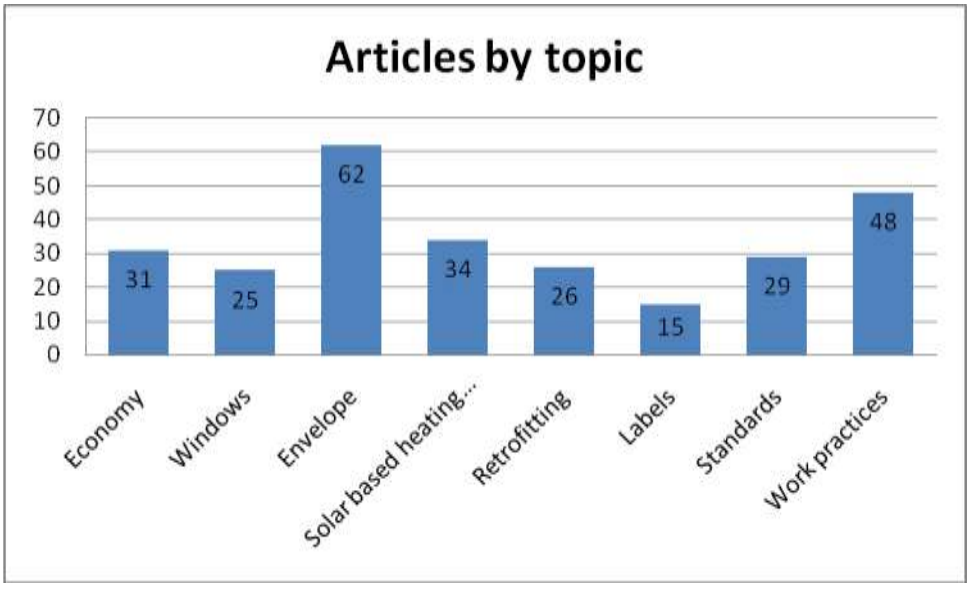
The discussion around the economy of energy effectivizing circulated around the tension between long and short term-profitability and costs of the energy effectivizing measures. The media suggests several different issues that keep the calculations focused on short term costs and profits including budgetary and financing practices and principles. This focus on the short-term economy is indicated as being problematic in terms of achieving energy efficient buildings. However, the media also mentions negative economic incentives that might influence the long-term profitability of energy saving measures. The discussion around the economy in energy effectivizing reveals price and profitability as interesting constructions the principles of which can be compiled in various different ways.

CONCLUSION

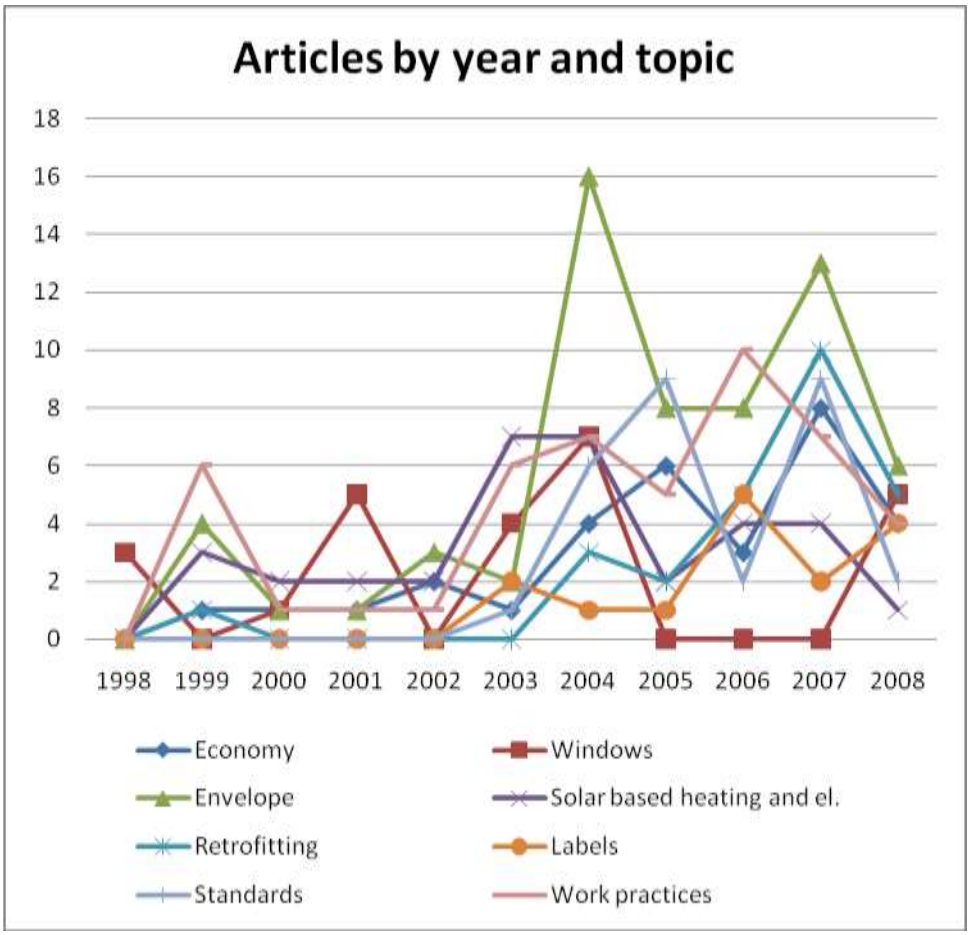
The Danish media express very similar understandings of the desirability of energy efficiency in the Danish construction sector. During the time span of this investigation, 1999-2008, the media were aligned in terms of seeing energy efficiency as an important goal that the industry and building owners should strive for. All in all, the dynamics of meaning production on energy efficiency in the media was less characterized by negotiations between different newspapers than by evolvement of similar understandings of an ideal state of energy efficiency, understandings of problems in realizing these ideals and problematizations and deproblematizations of the solutions for energy efficiency over time.

In the media writings, some topics were discussed frequently, including the energy efficiency of windows and other building elements, solar based heating and electricity production, energy renovation of buildings, energy labels and standards for low energy building, work practices and economy in energy efficient building. Also the revised building code appeared in many media writings. Other issues such as geothermal heat, effectivizing old heat production and delivery systems and heat pumps, for example, received much less attention. It can be concluded that Danish media emphasized some dimensions of energy efficiency thus participating in defining energy efficiency primarily to include particular issues.

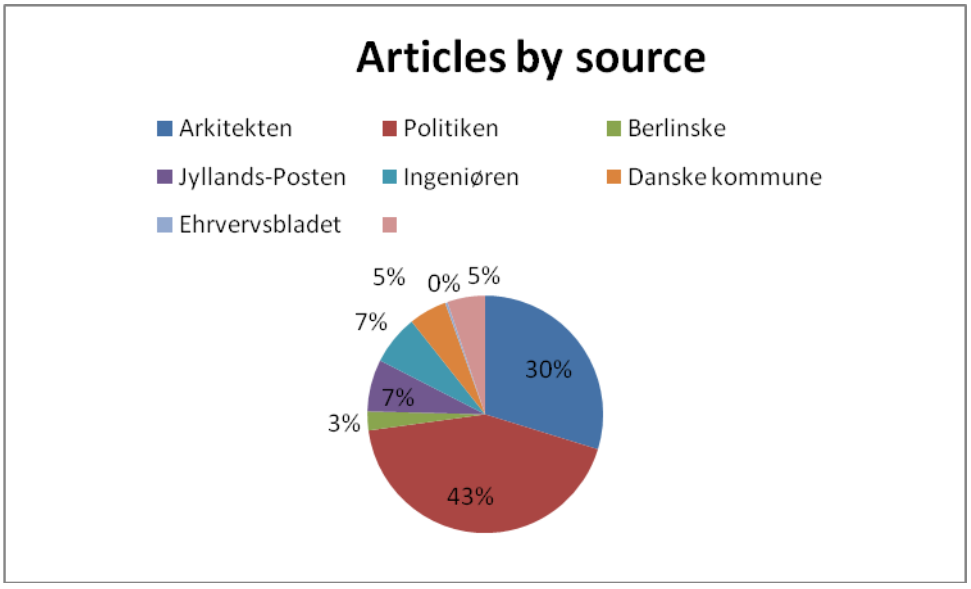


In the time span between 1998 and 2008, there was a slight change in the topics that were considered relevant by the media. Topics such as windows, the building envelope, solar based heating and electricity, work practices and economy in energy effectivization were all discussed throughout the time span of this investigation. Articles related to retrofitting, energy labels, low energy standards started to appear around 2003-04 onwards possibly linked to the discussions on the revision of the building code in 2006. 2003-2004 marked also a general increase in the number of articles on energy efficiency partly explained by the

inclusion of Byggeriet in the media sample. Interestingly, none of the themes mentioned above disappeared from the discussion in the given period of time.



Arkitekten and Byggeriet dominated the discussion in all areas. However, both these media had slightly different biases. While Arkitekten was remarkably more active in the area of windows, solar based power production and work practices, Byggeriet showed relatively more interest in retrofitting, energy labels and economy in energy effectivizing. Furthermore, issues related to aesthetics, such as day light and the form of the building, and indoor air quality were most prominently discussed in Arkitekten.



The discussion around energy efficiency was very much centred around the energy saving potential on one hand and on the possible solutions for inefficiency on the other hand. Solutions such as different materials and technologies, labels and standards as well as different work practices and management styles were considered in the media. While energy effectivizing as such was seen as positive, solutions for energy inefficiency received more critical treatment. The media brought up a number of negative consequences of proposed solutions for enhancing energy efficiency. These consequences included impacts on indoor air-quality, the aesthetic expression of the building and high start-up prices to name some.

The problematizations of energy efficient solutions reveal two kinds of tensions and trade-offs: 1) tensions between different dimensions of energy efficiency and 2) tensions between energy efficiency and other goals and dimensions in construction. In terms of different dimensions of energy efficiency, optimizing passive solar gain, for example, was argued to reduce the intake of day light. This would increase the use of electricity for lighting purposes. Another example on the conflicting dimensions of energy efficiency was that of enhanced insulation creating a need for air conditioning and thereby increased use of electricity in stead of heating.

Besides conflicts between different energy efficiency dimensions, solutions for energy efficiency were also presented as leading to compromises in other construction related goals and values both in aesthetic, creative and economic terms. For example, in the early 2000 energy efficient window frames were only available in broad models which were considered unaesthetic by Danish architects. Similar reactions were expressed regarding thick levels of insulation and solar panels. Furthermore, bringing in energy efficiency concerns in the early design process was suspected to restrict the creative process of designing a building. In some cases, for example in the case of window frames, the media seek to neutralize the conflict by introducing new technologies and solutions which could include both energy efficiency and the wanted

aesthetic expression. In terms of economy, the high start-up costs seemed to juxtapose energy renovation with other renovation objects.

Price and aesthetics were those qualities mostly referred to when negative consequences or barriers for energy effectivizing were named in the media. Interestingly, some articles on aesthetics and especially price portray the nature of these consequences as constructed. Price and profitability could be calculated in taking into a number of issues including long and short term costs, taxation, investment opportunities and so forth. The aesthetic expression of the building could be built around energy effectivizing technologies, e.g. solar panels, or could be spoiled by the very same technologies. Thereby, the consequences could be seen as negative or positive depending on the methods of evaluation. The different principles for calculations were mostly discussed in relation to price whereas the conflict between aesthetics and energy efficiency was mostly taken for given. Why and how these particular understandings of profitability or aesthetics become dominating was not discussed.

Besides discussion on the negative impacts of solutions on energy inefficiency, the media also suggests other barriers for using energy effective technologies and materials or changing construction practices and principles to more energy effective. These include lack of knowledge, reluctance of owners and professionals as well as negative financial incentives.

To summarize, the writings on energy efficiency in the Danish media portray energy efficiency as a multifaceted endeavour with a number of different fallbacks and opportunities - and great potential. The meaning of energy efficiency is produced in defining which thematics and solutions are relevant for either future or achieved energy efficiency. Technological development and innovations are powerfully involved in changing the topography of energy efficiency.

An important part of defining the relevance of particular solutions for energy efficiency are media negotiations on the adequacy and desirability thereof. Thus, the meaning of energy efficiency fluctuates in the problematizations and deproblematizations of different solutions for energy efficiency. Solutions for energy efficiency are problematized as for their impact on the energy performance of the building but also as for their relations to other areas of construction and building management, for instance building ownership taxation and window frame production processes to name some. Thereby the boarders for energy efficiency in building come to overlap with issues traditionally thought as separate from energy efficiency.

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